Seashore, Carl E. & T. L. Ling.

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BLIND AND SEEING PERSONS.

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THE COMPARATIVE SENSITIVENESS OF BLIND AND SEEING PERSONS

BY

CARL E. SEASHORE AND T. L. LING[1]

The blind have unquestioned superiority in their ability to use their touch, hearing, and other senses for guidance. From observation of this, the conclusion is generally drawn that the sensitivity of their sense organs is correspondingly heightened.

"Through years of experience in the laboratory, the conviction has gradually grown upon me that a more radical distinction should be made between sensitiveness and ability to use a sense; *i.e.*, between inborn sensory capacity and acquired ability or skill. From time to time I have taken the opportunity of comparing my own sensitiveness in touch and hearing with that of blind persons distinguished for ability in guiding themselves by hearing and touch; and in no case did I find that the blind persons possessed any significant superiority to myself in sensitiveness to touch and hearing, although some of the blind persons experimented upon were noted for their wonderful performances through hearing and touch."[2]

We finally found an opportunity to put the matter to an accurate and crucial test. Sixteen blind students from the Iowa College for the Blind at Vinton, Iowa, and fifteen pupils from the Iowa City High School were selected as cases for comparison. The ages of the blind ranged from sixteen to twenty-six and of the seeing from fourteen to nineteen. In selecting the blind, only those were chosen who had been totally blind for more dren we may use here the records of a group of one hundred and ninety-nine children, which comprise all the children in the seventh and eighth grades in the public schools of Charles City, Iowa.

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[1] The writers acknowledge their great obligation to Superintendent Eaton for courtesies and coöperation at the School for the Blind and to Dr. Mabel C. Williams for taking responsible part in the making of the measurements, and taking the case histories of the blind children.

[2] Seashore, Carl E., Elemental Tests in Psychology, *J. of Educ. Psychol.*, 1916, 7, 81.

The comparison of the distribution for these children with the distribution for adults is shown in Fig. 6, in which the curves are based upon the per cent. of correct judgments irrespective of demerits. Here is then a clear-cut picture of the ability of children of this age as compared with adults.

The following table is a comparison of the percentile rank of adults and children according to the per cent. of correct judgments. The first and second columns give the per cent. of correct judgments which an adult and a child respectively would have to make in order to get the percentile rank set opposite in the third column. It will be seen that in order to be average in the perception of consonance, or to get a percentile rank of 50, an adult needs to make 70% of correct judgments, while a seventh or eighth grade child must make 54% of correct judgments.

Adult	*Child*	*% Rank*
100	97	100
86	79	90
82	69	80
77	66	70
75	60	60
70	54	50
66	48	40
61	43	30
54	33	20
46	21	10
9	0	0

The establishment of norms for children and their evaluation for different ages represents a large task in the midst of which we are now engaged. In view of the strenuous nature of the test, one must be impressed with the relatively small difference between the achievement of adults and children. This fact becomes even more impressive upon examination of individual evidences. Thus, many of the children make as good a record as the best of the adults, and the disparity between the showing of children and adults comes largely from the incompetency of the comparatively dull children.

than five years, who were generally otherwise both mentally and physically sound, and were now in high school grades. This resulted in the selection of the ablest pupils in the school. The seeing pupils were taken at random, being selected by the principal on the ground of convenience of schedule. On each of these the following six measurements were made.

List of tests

1. *Localization of sound.*—Discrimination for the direction of sound was measured in terms of the angular displacement in the horizontal plane directly in front of the observer. A click in a telephone receiver served as stimulus. The receiver was mounted at one end of a two-meter bar which was pivoted at the middle and carried a pointer running over a scale of degrees at the other end. This apparatus was mounted at such distance in front of the observer that the receiver moved at the distance of one meter from the center of the head. The click was produced by the rapid make and break of the circuit through the mercury key. This whole arrangement proved very accurate and convenient, inasmuch as the angular displacement at this point and in this direction is very small. After a preliminary determination of the threshold one hundred trials were made by the method of constant stimuli.

2. *Discrimination for the intensity of sound.*—This was measured by determining whether the second of two consecutive tones which differed in intensity only, was stronger or weaker than the first. The tones were produced by a one hundred vibration electro-magnetic fork in circuit with the audiometer[3]. A standard current of 1.2 volts was used and No. 30 on the audiometer was taken as the basal unit, the compared tones being either stronger or weaker. This provides a tone clearly audible and yet not unpleasantly strong. The records were kept in terms of the units of the audiometer, which represent approximately equal psycho-physic steps. After preliminary determination of the threshold, one hundred trials were given by the method of constant stimuli.

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[3] Seashore, New Psychological Apparatus, *Iowa Studies,* Vol. II, pp. 153-163.

3. *Discrimination for lifted weights.*—A set of bottles forty millimeters in diameter and ninety-five millimeters high was arranged as follows: 3 standards at 80 grams each and 12 compared weights yielding a series—81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 92, and 95 grams. The observers were blindfolded and the standard weights were changed in order to eliminate the temperature error. The weights were arranged with ample space on a small revolving table so that any desired weight could be swung into position without noise. After the preliminary determination of the threshold, one hundred trials were made by the method of constant stimuli.

4. *Discrimination for passive pressure.*—A modified form of the Stratton pressure balance[4] was used. This was built of aluminum which was lighter and therefore more sensitive than the original. By this form of the apparatus it was possible to increase or decrease the standard pressure instantaneously without the slightest jar. The standard pressure was five grams upon the outer side of the third phalanx of the first finger. The pressure location of this was changed slightly for successive trials and the least perceptible increase or decrease in weight was determined, one hundred trials being made by the method of constant stimuli after the preliminary threshold had been determined.

5. *Discrimination for active pressure.*—This was measured by determining under how many thicknesses of paper the position of a wire hair could be located by active exploration with the tip of the first finger. The apparatus consisted of a plate glass disc 10 cm. in diameter, mounted so as to revolve freely. In place of the hair a copper wire, No. 38 B & S, which is about the diameter of the average human hair, was stretched across the plate glass and with ends firmly fastened. Discs of paper cut from Old Veda Bond 17 x 22, twenty pounds to the ream, were placed over this wire, and the blindfolded observer was required to locate the direction of the wire through touch. Starting with ten sheets, five sheets were added for each trial until

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[4] Stratton, Über die Wahrnehmung von Druckänderungen bei verschiedenen Geschwindigkeiten, *Philos. Stud.*, Vol. 12, 1896, pp. 525-586.

a failure occurred; then a single sheet was taken off or added until the greatest thickness through which the wire could be located had been determined. The record is therefore given in terms of the number of sheets of paper covering the wire. To one who has not performed this test, the actual results will seem to be very wonderful achievements, as the records show.

In this test much depends upon economic procedure in the hunting. The observers were therefore carefully taught how to proceed: *e.g.*, to run tip of finger from left to right and, if the wire was not found in that stroke, to run it in a line at right angles to the first; the wire being found by such economic procedure, it was comparatively easy to trace it. If it was not found in the first two strokes, these cardinal movements were continued until the observer acknowledged failure.

6. *Tactual space.*—This consists in the determination of the two-piont threshold in the transverse direction on the tip of the first finger and in the transverse direction on the inside of the forearm, 5 cm. above the wrist.

It is unfortunate that no more than one hundred trials could be made in each of these tests, where the method of constant stimuli was employed, but it must be remembered that much time, more than was required for the actual measurement, was spent in making preliminary determination and securing adaptation which is necessary for tests of this sort. Indeed the elemental character of the tests often hinges largely on full knowledge of all factors involved and skill in preparing the observer so as to eliminate sources of subjective and objective variables.

Case histories: 1. The blind

Case 1. Age, 16, female. Blindness began three days after birth. Can only distinguish light from darkness. Attractive, bright, quick, responsive, and breathlessly attentive, but easily fatigued; reads point with either hand at conversational rate; likes typewriting, plays the piano well, and sings; can hem by hand but does not use a sewing machine; taste and smell are good; has no difficulty in finding her own way on the premises.

Case 2. Age, 26, female, single. Cause of blindness *iridocyclitis;* trouble came on gradually from ten to nineteen. Can tell where windows are in a room; healthy and cheerful, but slow; responsive and tried hard in the tests;

reads point slowly with right hand and follows with left; studied typewriting for a while but dropped it; can sew by hand or machine, crochet, knit, tie, and do housework; has learned basketry, weaving, and broom making; has studied piano two years; taste and smell good.

Case 3. Age, 25, male, single. *Congenital cataract.* Can tell light from darkness; taste and smell good; relies much on hearing; is of a nervous temperament, unattractive, but quiet; critical and sure of himself; reads point slowly with left index finger; uses typewriter, studied piano nine years; profession, piano tuning; also makes brooms, ties, and weaves.

Case 4. Age, 19, female. Blindness due to *leucoma adherens* from *blennorrhea neonatorum;* commenced shortly after birth; can locate windows with left eye; can sort laundry by smell; makes much use of hearing; was fidgety and sighed frequently during the test; bright and alert; reads point rapidly with both hands; plays piano well; sews either by hand or machine; skillful in basketry and fancy work.

Case 5. Age, 23, female, single. Blindness due to *sympathetic ophthalmia;* ran a knife into her right eye when a child and failed to get proper treatment; can tell daylight from darkness with her left eye; goes about alone in usual places but never on the street; reads point with both hands at conversational rate; sews, ties, crochets, etc.; tries to do all kinds of house work; plays the piano well; fine young woman, neat and pleasing, quiet manner.

Case 6. Age, 18, male. Blindness due to *phthisis bulbi* from *blennorrhea neonatorum;* pleasing appearance, alert, attractive, but fatigues readily; reads point with left index finger at conversational rate and anticipates with right; uses typewriter well; is musical and sings well; guides himself in the environment without difficulty.

Case 7. Age, 19, male. Blindness due to *phthisis bulbi.* Stuck a shoe awl into right eye when nine years old and rapidly lost sight of both eyes a year later. Guides himself in environment with skill and ease; taste and smell good; basket weaving, broom making; carpet weaving; reads point slowly with left index finger; plays piano and violin a little; likes typewriting.

Case 8. Age, 19, male. Blindness due to chronic *conjunctivitis;* began when six months old. Can locate windows and see the light of the sun but not the sphere itself; taste and smell good; cheerful, reliant, and mentally probably a little above the average; reads point; tunes piano; takes typewriter apart just for the fun of it; has a work shop and whole set of tools at home; built a house seven feet square twenty feet up in a tree two years ago.

Case 9. Age, 19, female. *Atrophy of optic nerves* due to accident at age of fourteen. Intelligent and responsive and tried hard in the tests; uses typewriter; is skillful in basketry and fancy work.

Case 10. Age, 17, male. Blindness due to chronic *iridocyclitis* caused by *spinal meningitis* at six months. Lost sight suddenly at age of twelve; taste and smell good; reads point with either hand at conversational rate; can work in the garden, but not hoe; makes baskets and hammocks.

Case 11. Age 19, female. Blindness due to *sympathetic ophthalmia;* ran scissors into left eye when four years old; right eye failed gradually. Can see light, locate windows, and avoid obstacles; ordinary intelligence; reads point with left index finger at conversational rate but not with right hand at all; plays the piano; uses typewriter, sews, and does fancy work.

Case 12. Age, 19, male. Blindness due to *maculae corneae from blennorrhea neonatorum.* Goes about the city alone; learns new towns quickly; conscious of using hearing extensively; responsive and attentive; boastful; reads point well; plays pipe organ, piano, and violin; gives concerts.

Case 13. Age, 20, female. Blindness due to *congenital atrophy* of optic nerves. Taste and smell good, but does not use them much; good orientation; nervous; reads point with right index finger, left following; uses typewriter, sews, and does fancy work.

Case 14. Age, 21, female. Blindness due to *phthisis bulbi* from *blennorrhea neonatorum.* Can detect light with the left eye; reads point and braille with either hand but faster with the right; plays piano and sings well; sews and does fancy work, and house work.

Case 15. Age, 25, female, single. Blindness due to *phthisis bulbi* from *blennorrhea neonatorum.* Cannot detect light; taste and smell good; responsive, good application; reads braille better than point; sews and does fancy work and light house work.

Case 16. Age, 20, female. Blindness due to *phthisis bulbi* from *blennorrhea neonatorum.* Can detect light and sometimes colors and outlines of persons; bright, very attentive; reads point with right index finger rapidly and is considered one of the best; uses typewriter, plays piano, and pipe organ, sews, and does house work.

2. *The seeing*

Case 1. Age, 18, male, junior. A good student.
Case 2. Age, 14, male, freshman. A medium student.
Case 3. Age, 17, female, junior. A medium student.
Case 4. Age, 16, male, freshman. A medium student.
Case 5. Age, 21, male, senior. A superior student.
Case 6. Age, 17, male, freshman. A medium student.
Case 7. Age, 17, male, freshman. A medium student.
Case 8. Age, 19, female, junior. A good student.
Case 9. Age, 18, female, senior. A very bright student.
Case 10. Age, 17, male, senior. A medium student.
Case 11. Age, 18, male, senior. A medium student.
Case 12. Age, 18, female, senior. A medium student.
Case 13. Age, 15, male, sophomore. A medium student.
Case 14. Age, 15, male, freshman. A very poor student.
Case 15. Age, 15, male, sophomore. A good student.

TABLE I—*The blind*

Cases	Localization of Sound	Intensity of Sound	Lifted Weight	Pressure	Touch	Tactual Finger	Space Arm
	Degrees	*Units*	*Grams*	*Grams*	*Sheets*	*m. m.*	*m. m.*
1	1.4	1.5	3.1	.64	25	1.5	20
2	3.0	2.0	5.6	.32	32	1.8	
3	5.2	.5	4.0	.63	31	1.3	51
4	1.4	1.3	3.2	.18	21	1.6	30
5	1.3	1.4	4.8	.66	35	1.5	35
6	1.8	.8	4.3	.46	30	1.1	21
7	2.1	2.0		.34	30	.6	27
8	2.0	.8	2.5	1.31	35	1.0	12
9	4.8	1.4	5.2	.66	29	1.1	47
10	2.0	.7	3.0	.38	10	.9	20
11	2.1	1.8	6.6	.38	25	.8	5
12	1.3	.7	1.7	.35	38	1.3	24
13	1.4	1.1	4.0	.22	19	2.3	20
14	1.2	1.2		.51	18	1.3	16
15	1.6	.9	4.0	.70	15	.8	30
16	1.6	.8	4.0	.25	20	2.0	24
Median	*1.6*	*.9*	*4.0*	*.38*	*25*	*1.1*	*24*
Ave..	*2.1*	*1.2*	*4.3*	*.50*	*26*	*1.3*	*25*
M.V.	*.8*	*.4*	*.9*	*.20*	*6.7*	*.4*	*8.6*

TABLE II—*The seeing*

Cases	Localization of Sound	Intensity of Sound	Lifted Weight	Pressure	Touch	Tactual Finger	Space Arm
	Degrees	*Units*	*Grams*	*Grams*	*Sheets*	*m. m.*	*m. m.*
M 1	1.5	1.0	2.9	.13	41	.6	26
M 2	4.4	1.6	5.2	.98	14	2.1	19
3	2.0	1.0	2.4	.87	18	1.0	35
M 4	2.2	1.0	4.6	.50	28	1.7	38
M 5	2.2	.7	3.0	.35	40	1.6	33
M 6	1.4	1.6	3.3	.72	47	1.2	26
M 7	2.8	1.1	4.0	.44	36	1.1	46
8	1.9	.9	2.2	.58	35	2.1	22
9	2.7	1.0	4.1	.80	30	1.6	18
M 10	1.6	.5	4.2	.40	21	2.0	35
M 11	1.9	.5	3.1	.73	32	1.0	11
12	1.6	1.2	4.4	.54	45	1.6	23
M 13	.5	.3	1.7	.43	25	.2	10
M 14	4.0	1.5	3.1	.44	21	2.0	18
M 15	2.9	2.2	4.4	.23	20	.5	25
Median	*2.0*	*1.0*	*3.3*	*.44*	*28*	*1.2*	*23*
Ave.	*2.2*	*1.1*	*3.5*	*.54*	*30*	*1.3*	*25*
M. V.	*.7*	*.4*	*.8*	*.18*	*8.6*	*.52*	*7*

Statement of the results

Localization of sound.—In this test the blind are slightly superior to the seeing, especially in terms of the median. The blind vary more than the seeing, the coefficient of variability being 33 and 48 for the blind and the seeing respectively. The records of the former range from 1.2 to 5.2 degrees while the latter vary from .5 to 4.4. The finest record of all was made by a seeing person.

The intensity of sound.—In this test the blind are slightly superior to the seeing according to the median but inferior by the same amount according to the average. The coefficient of variability is practically the same, namely, 32 for the blind and 33 for the seeing. Here again the best record of all is made by a seeing person, the same one, No. 13, who made the best record in localization of sound.

Lifted weights.—In this test the blind are inferior to the seeing both according to the median and the average. The coefficient of variability is approximately the same, 23 for the blind and 24 for the seeing. Here the finest record made is the same for the blind as for the seeing. But there are more extremely poor records among the blind than among the seeing.

Pressure.—In this test the blind are somewhat superior to the seeing both according to the median and the average. The blind are more variable, the coefficient being 40 for the blind and 33 for the seeing. The records of the blind range from .18 to 1.31 and those of the seeing from .13 to .98.

Touch.—In this test the larger the number the better the record. The facts therefore show that the blind are inferior to the seeing both according to the median and the average. There is but slight difference in the variability although the seeing have four records that are better than the best record of the blind.

Tactual space on the finger.—In this test there is no significant difference in the median and the average. But the variability of the seeing is greater, the coefficient being 40 for the seeing and 27 for the blind. The seeing have two records that are better than the best of the blind.

Tactual space on the arm.—Here again there is no significant difference in the median and the average nor in the coefficient of variability.

The general conclusion then so far as the net results of the facts are concerned must be this, that, while there are slight differences shown in the Tables, there is no *significant* constant tendency in the records to favor either the blind or the seeing. In other words, *the blind and the seeing under these circumstances are, on the whole, equally sensitive to the direction of sound, intensity of sound, lifted weight, passive pressure, active pressure, and tactual space.*

Interpretation of these findings

These experiments were planned on the assumption that the tests would be elemental; *i.e.,* that the measurements were so simple and natural that training, experience, and special skill would not affect the results. In other words we aimed to test native capacity as distinguished from acquired ability.

From one point of view we may say, therefore, that the outcome of this series of experiments is to prove that the specific tests here used are elemental, because the records do not favor those who have acquired very marked skill and efficiency in these senses. That itself is an important feat in experimental procedure, because it sets up a new standard for psycho-physic tests. Records of psychological and psycho-pedagogical experiments for the past twenty-five years are full of examples showing how capacities like those here mentioned improve with age, intelligence, and practice. If the above conclusion is right we must re-submit those findings to determine to what extent the improvement found was due to the maladaptation of the experiment and the lack of skill of the experimenter rather than to characteristic change in the persons measured.

We cannot too strongly emphasize the necessity of reducing the procedure in an experiment of this kind to its simplest terms so that the record shall be of the actual capacity rather than of the possession of skill in adjusting oneself to a complex situation. There are scores of pitfalls in each one of the above experiments, which, if allowed to enter uncontrolled, would detract from the elemental nature of the test.

If we regard the results then from the converse side, they prove that the extraordinary skill in guidance through hearing and pressure and other senses in the blind has its basis in apperception rather than in sensation or in the direct and immediate judgment of difference. The person who reads the point print has learned to give meaning to sensory impressions which the seeing person tends to neglect although possessed of the same power as the blind in sensing these differences.

If, then, we say that the blind person who reads point print, almost as we read with our eyes, and guides himself through hearing in many respects almost as we guide ourselves with our eyes, and we regard these performances as representative of the thousands and thousands of situations which occur in life, we arrive at the conclusion that the seeing have countless wonderful capacities lying latent and unrecognized so far as conscious use is concerned. The apparent squandering of sensory capacities may well be compared with the great waste in the struggle for existence by various forms of prolific extravagance in reproduction. We are very richly endowed with capacities of which we employ only relatively few, and these in a very inadequate way. The achievements of Helen Keller, *e.g.,* illustrate this.

But after all, it is difficult to appreciate the full extent to which we actually do depend upon the sort of fine sensitiveness here measured. While most of us do not read with our finger tips or guide ourselves with our ears when walking, we do make constant use of these senses in ordinary activities, most of it unconsciously. It may, therefore, be said, from one point of view that, that while seeing persons are not trained in certain specific acts of skill, they are trained in the use of the sensibilities involved in such skill. Indeed we are born with hierarchies of blind "instinctive skill". We often appeal from the sense of sight to touch and we constantly respond to the environment through hearing without resort to the physical mechanism in terms of which we think.

Technically all these tests involved discrimination as distinguished from sensitiveness or sensibility. The sensory judgment is reduced to its lowest terms and is not far different from perception in its immediacy.

The conclusions of these experiments may then be summed up in the following statements:

First. The blind who are skillful in the use of touch, muscle sense, and hearing are not more sensitive or keen in sensory discrimination than seeing persons when fundamental capacities are tested.

Second. The necessity of making our psycho-physical tests elemental is strikingly indicated by the results of these tests.

Third. Development of the use of a sense consists not in the heightening of sensitivity or sensory discrimination but in the development of complexes and meanings in terms of these.

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